ROADMAP

Introduction to MARSAME

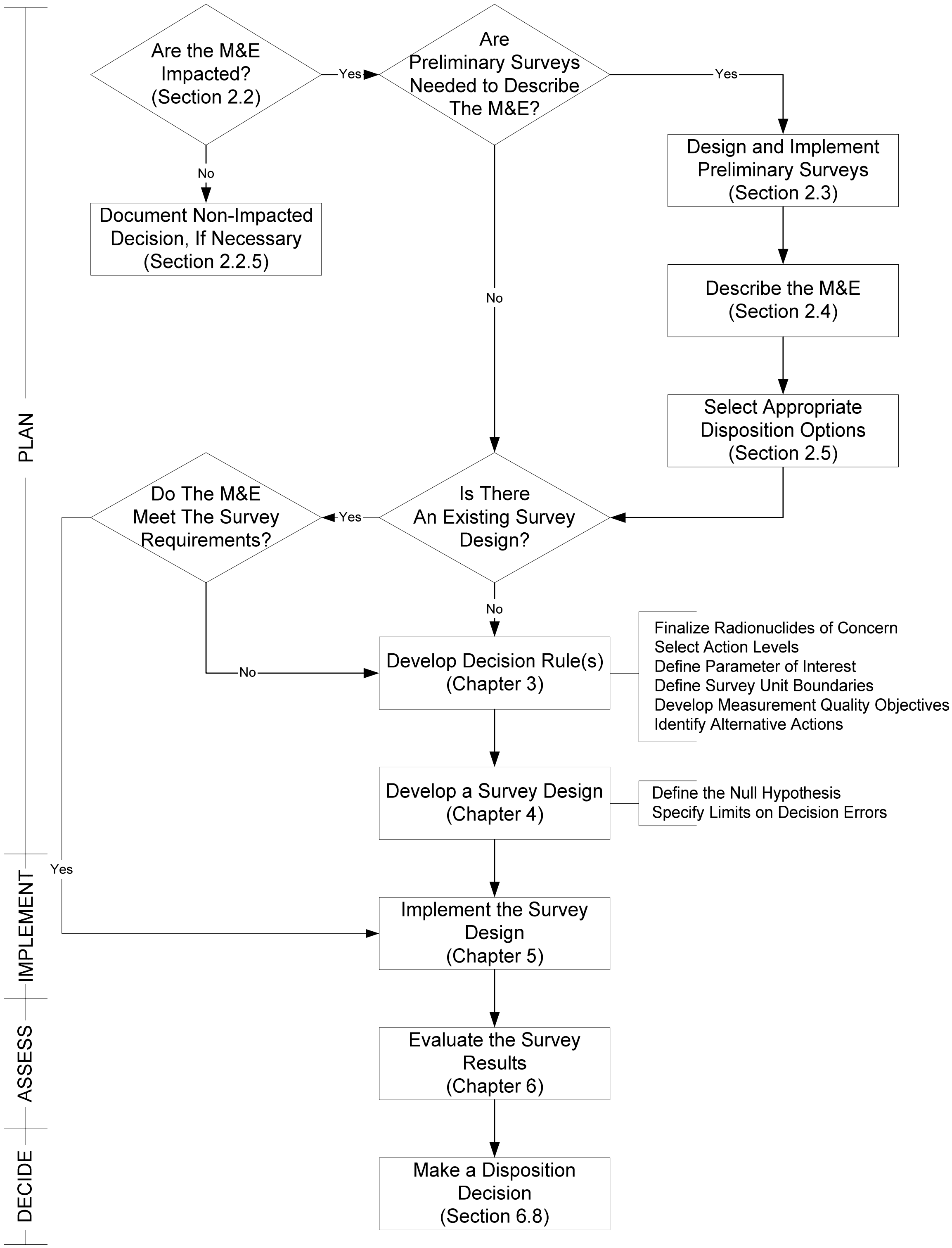
The Multi-Agency Radiation Survey and Assessment of Materials and Equipment (MARSAME) is a supplement to the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM 2002). MARSAME provides technical information on approaches for planning, implementing, assessing, and documenting surveys to determine proper disposition of materials and equipment (M&E).

The technical information in MARSAME is based on the Data Life Cycle, similar to MARSSIM. Survey planning is based on the Data Quality Objectives (DQO) Process and is discussed in MARSAME Chapters 2, 3, and 4. Implementation of the survey design is described in MARSAME Chapter 5, with discussions on selection of instruments and measurement techniques as well as handling and segregating the M&E. MARSAME also includes the concept of measurement quality objectives (MQOs) for selecting and evaluating instruments and measurement techniques from the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP 2004). Assessment of the survey results uses Data Quality Assessment (DQA) and the application of statistical tests as described in MARSAME Chapter 6.

The scope of MARSSIM was limited to surfaces soils and building surfaces. The scope of MARSAME is M&E potentially affected by radioactivity, including metals, concrete, tools, equipment, piping, conduit, furniture and dispersible bulk materials such as trash, rubble, roofing materials, and sludge. The wide variety of M&E requires additional flexibility in the survey process, and this flexibility is incorporated into MARSAME.

The Goal of the Roadmap

The increased flexibility of MARSAME comes with increased complexity. The goal of the roadmap is to assist the MARSAME user in negotiating the information in MARSAME and determining where important decisions need to be made on a project-specific basis, as summarized in Roadmap Figure 1.



Roadmap Figure 1. The Data Life Cycle Applied to Disposition Surveys

The roadmap is not designed to be a stand-alone document, but to be used as a quick reference to MARSAME for users already familiar with the process of planning, implementing, and assessing surveys. Roadmap users will find flowcharts summarizing major decision points in the survey process combined with references to sections in MARSAME with more detailed information. The roadmap assumes a familiarity with MARSAME terminology. Section 1.2 of MARSAME discusses key terminology, and a complete set of definitions is provided in the glossary.

Initial Assessment

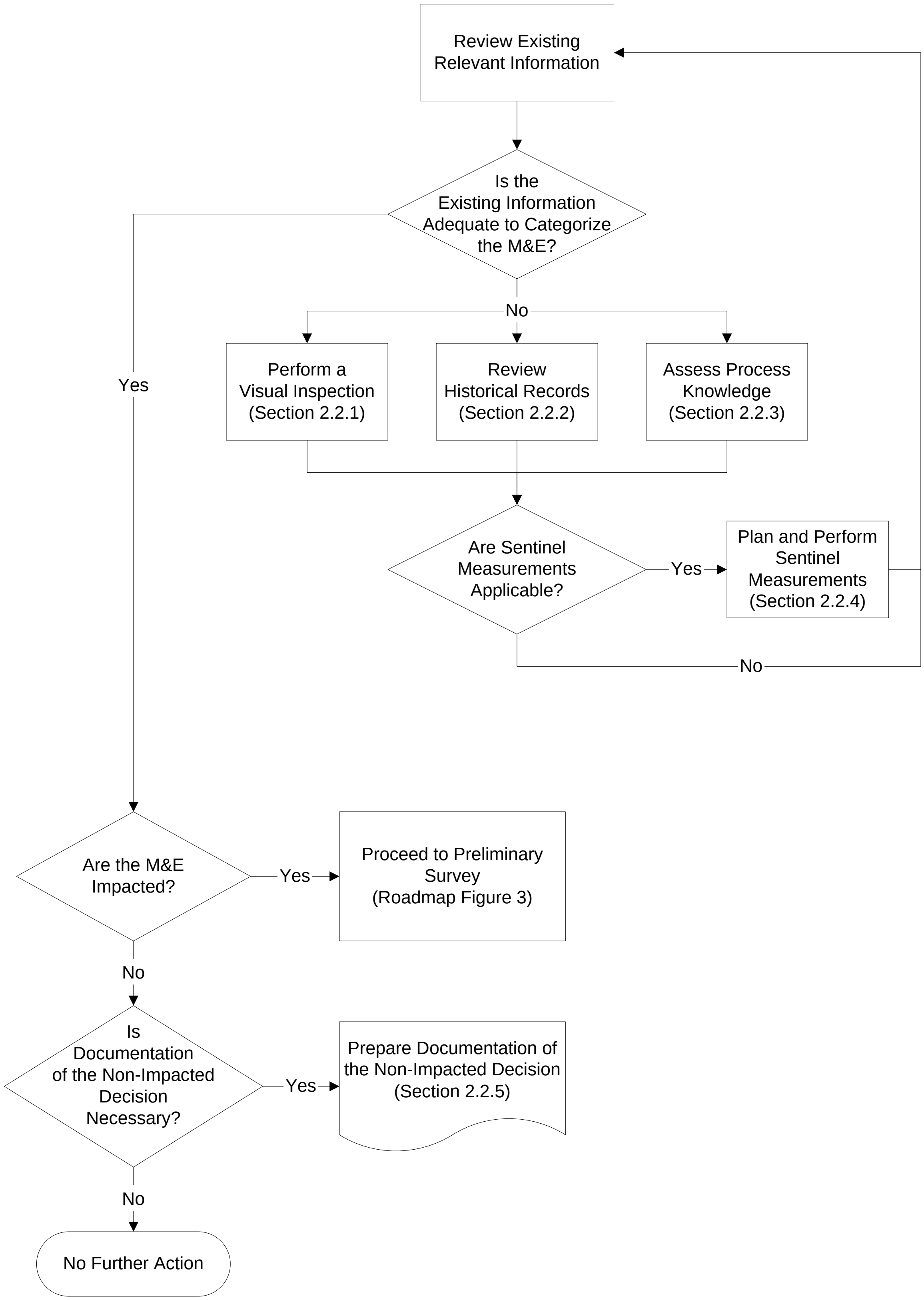
The Initial Assessment (IA) is the first step in the investigation of M&E, similar to the Historical Site Assessment (HSA) in MARSSIM. The purpose of the IA is to collect and evaluate information about the M&E to support a categorization decision and support potential disposition of the M&E (e.g., release or interdiction). Project Managers are encouraged to use the IA to evaluate M&E for other hazards (e.g., lead, PCBs, asbestos) that could increase the complexity of the disposition survey design or pose potential risks to workers during subsequent survey activities (see Section 5.2), or to human health and the environment following subsequent disposition of the M&E.

Categorization

MARSAME uses the term categorization to describe the decision of whether M&E are impacted or non-impacted. M&E with no reasonable possibility for containing radioactivity in excess of natural background, fallout levels, or inherent levels of radioactivity are non-impacted. Impacted M&E have a reasonable possibility for containing radioactivity in excess of these levels. Roadmap Figure 2 shows the categorization process as part of initial assessment (IA).

Standardized Survey Designs

Most operating radiological facilities maintain standard operating procedures (SOPs) as part of a quality system. In many cases these SOPs include instructions for conducting disposition surveys. The first step in evaluating an existing SOP is to determine whether there is adequate information available to design a disposition survey. If the existing information isn’t adequate to design a disposition survey, it isn’t adequate for



Roadmap Figure 2. The Categorization Process as Part of Initial Assessment

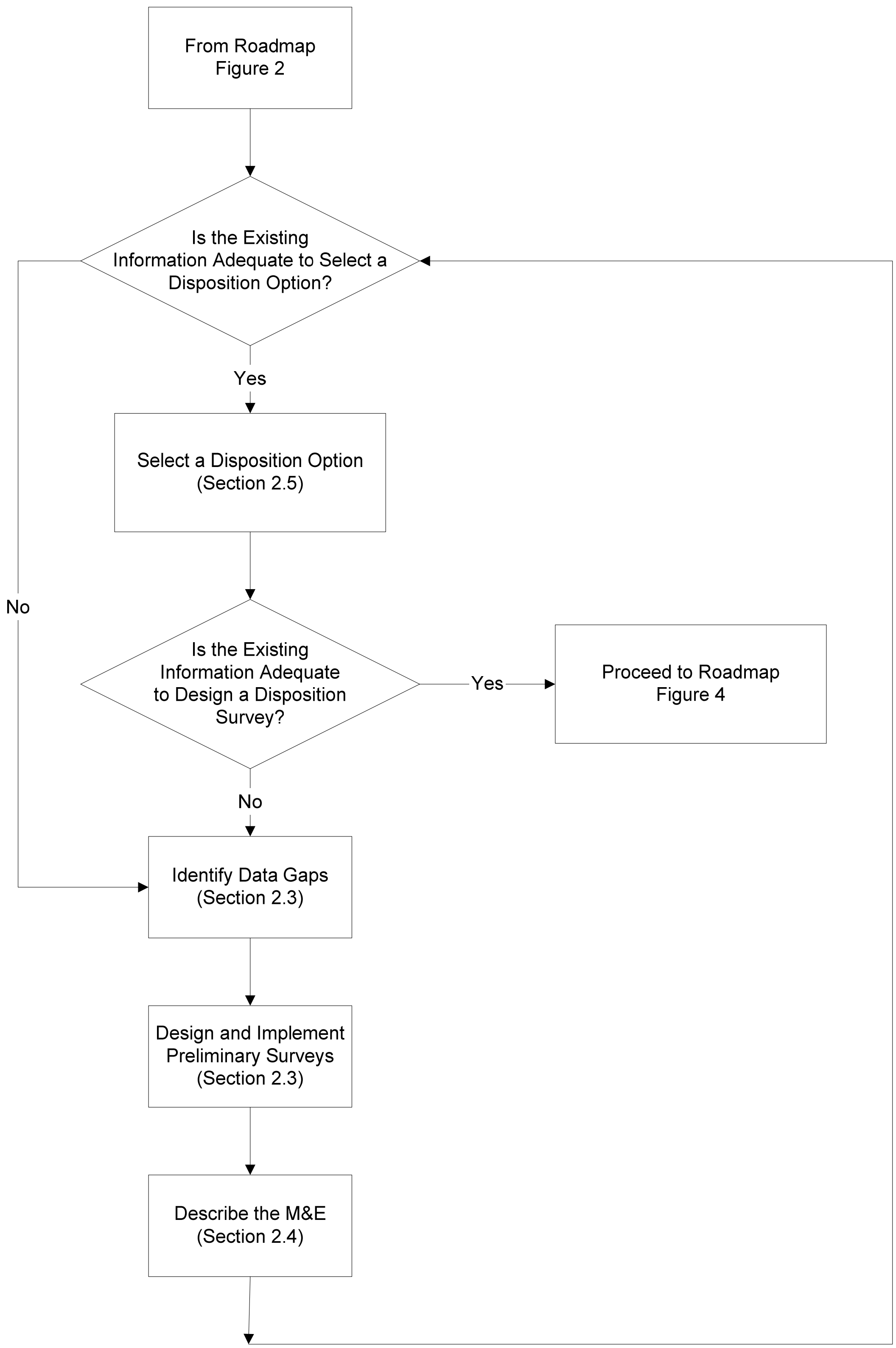
determining if an existing survey design is adequate either. Roadmap Figure 3 addresses assessing the adequacy of existing information for designing disposition surveys. Roadmap Figure 4 shows how implementing an existing SOP that is applicable to the M&E being investigated takes the user from MARSAME Chapter 2 to MARSAME Chapter 6. If a project-specific survey design needs to be developed, Roadmap Figure 4 directs the user to the information in MARSAME Chapter 3.

In some cases it may be possible to modify the M&E to match the assumptions used to develop the existing SOP, or modify the existing SOP to address the M&E being investigated. M&E may be modified by changing the physical attributes described in Table 2.1 or the radiological attributes described in Table 2.2. Modifications to the SOP are most often associated with MQOs such as the measurement detectability (see Section 5.7) or measurement quantifiability (see Section 5.8). Modifying the MQOs may result in small changes such as an increased count time (e.g., to account for an increase in measurement uncertainty or a decrease in counting efficiency) or larger changes such as selecting a different instrument (e.g., a gas-proportional detector instead of a Geiger-Mueller detector) or a different measurement technique (e.g., in situ measurements instead of scan measurements). Information on evaluating an existing survey design to determine if it will meet the DQOs for the M&E being investigated is provided in Section 3.10.

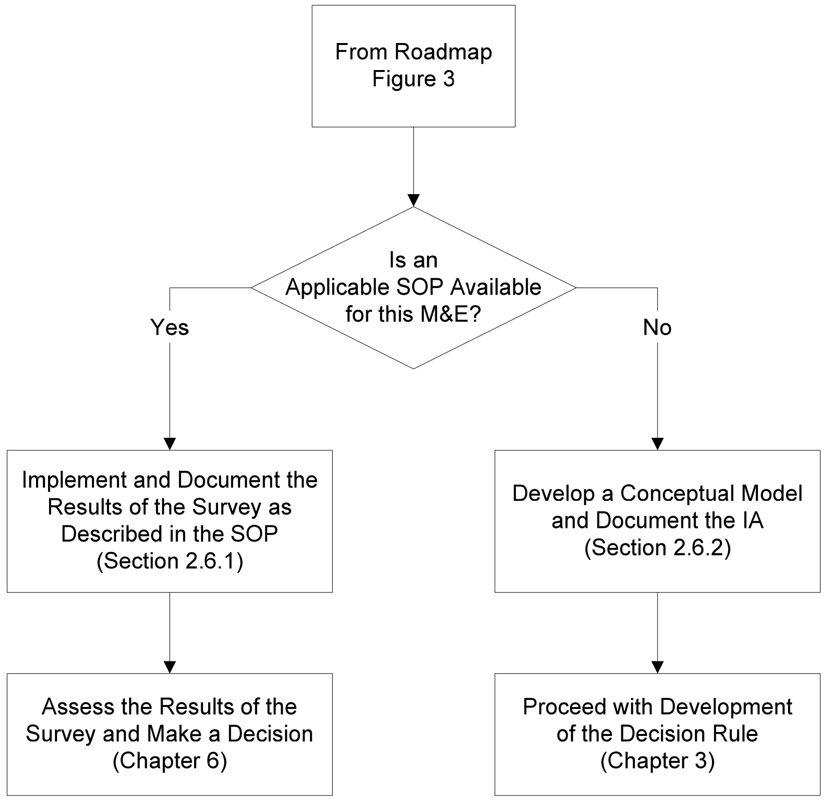
Develop a Decision Rule

MARSAME Chapter 3 focuses on developing a decision rule by identifying inputs to the decision. A decision rule is a theoretical “if…then…” statement that defines how the decision maker would choose among alternative actions. There are three parts to a decision rule:

- An action level that causes a decision maker to choose between the alternative actions (see Roadmap Figure 5 and Section 3.3),
- A parameter of interest that is important for making decisions about the target population (see Section 3.4), and
- Alternative actions that could result from the decision (see Section 3.5).



Roadmap Figure 3. Assessing Adequacy of Information for Designing Disposition Surveys

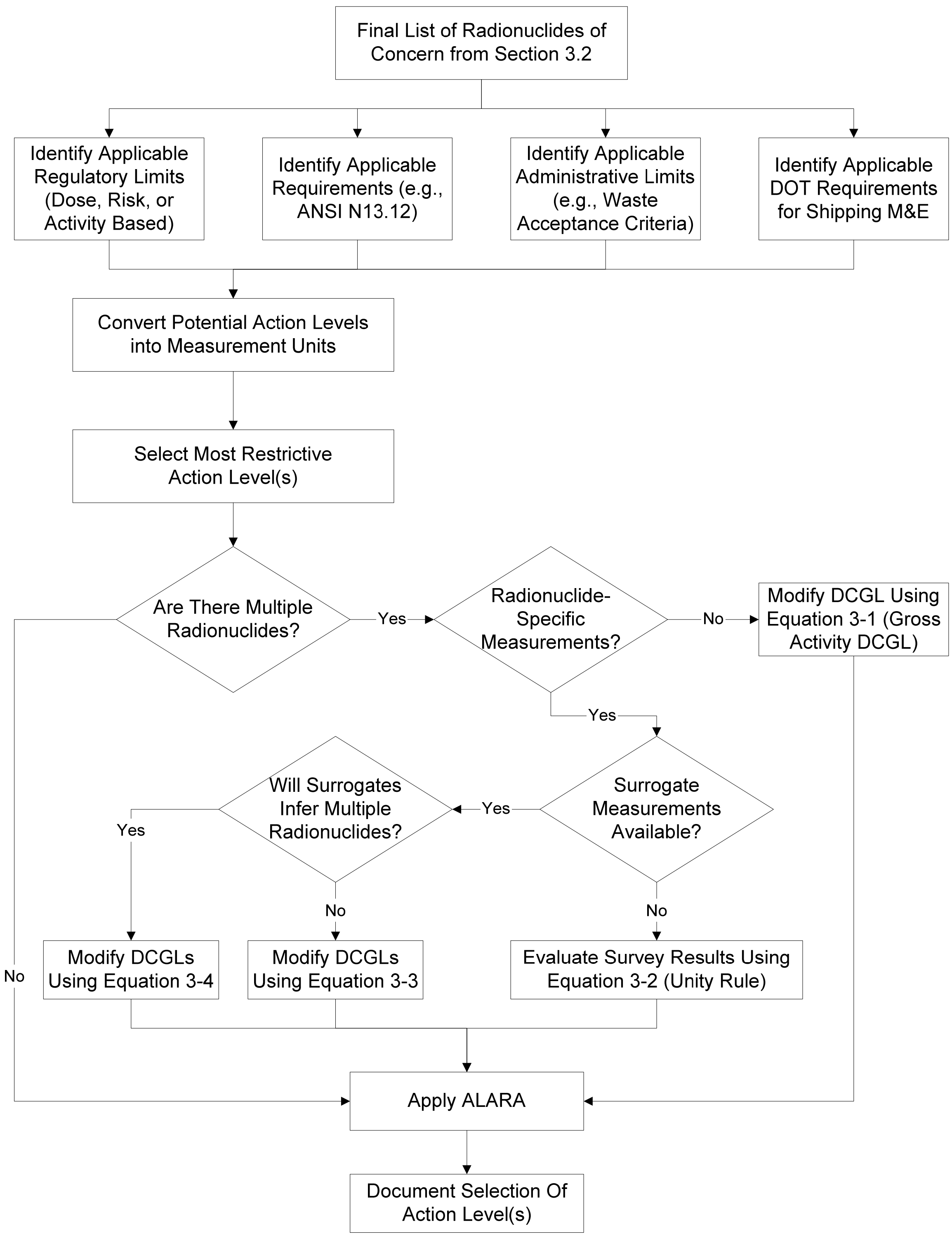


Roadmap Figure 4. Assessing the Applicability of Existing SOPs

Other inputs to the decision that are discussed in MARSAME Chapter 3 include selecting radionuclides or radiations of concern (see Section 3.2), developing survey unit boundaries (see Section 3.6), inputs for selecting provisional measurement methods (see Section 3.8), and identifying reference materials if necessary (see Section 3.9).

Survey Design

Once a decision rule has been developed, a disposition survey can be designed for the impacted M&E being investigated. The disposition survey incorporates all of the available information to determine the quality and quantity of data required to support a disposition decision. Roadmap Figure 6 shows a flow diagram describing disposition survey design.



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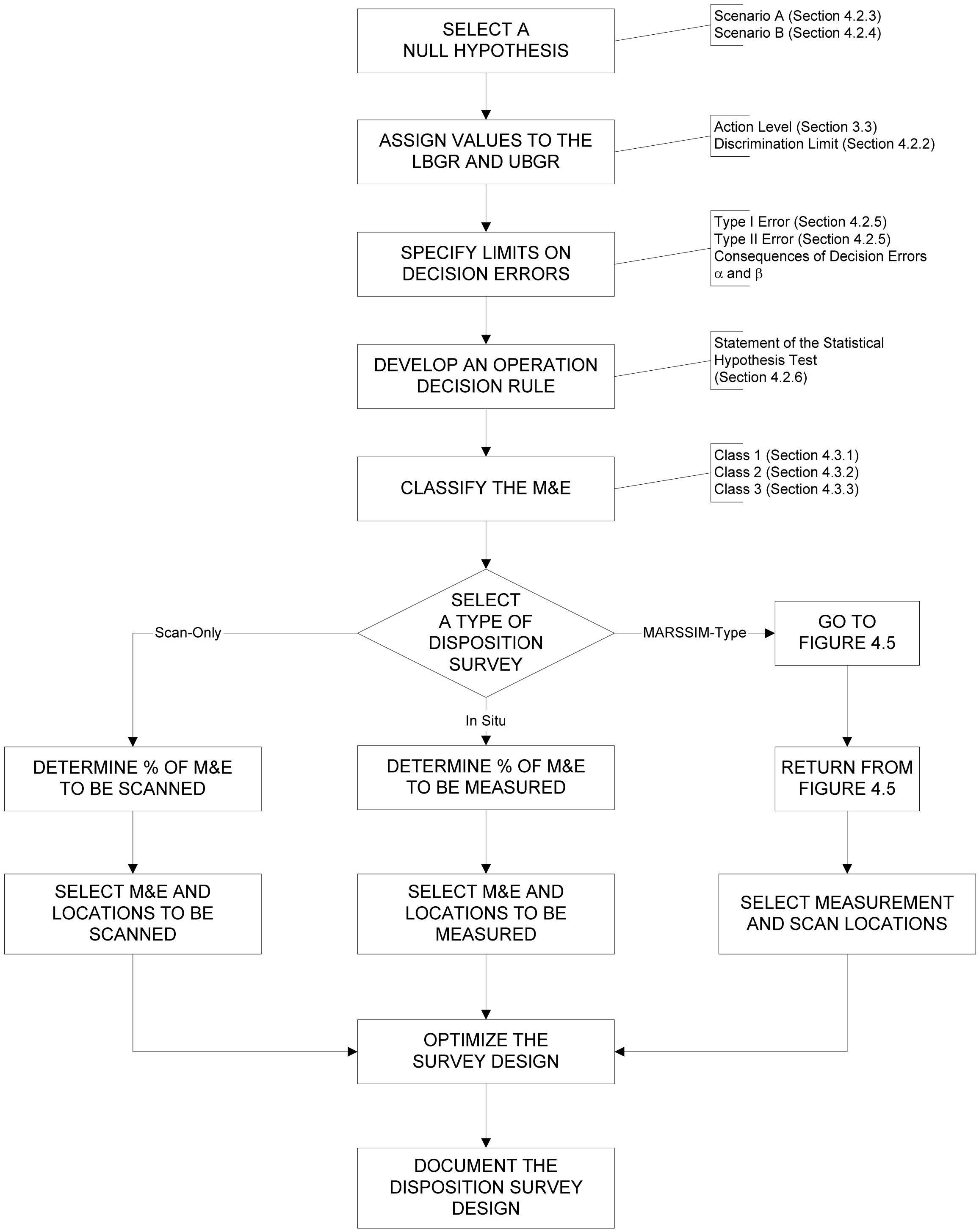
106 **Roadmap Figure 5. Identifying Action Levels**



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108 **Roadmap Figure 6. Flow Diagram for Developing a Disposition Survey Design**

MARSAME, like MARSSIM, provides information on using a null hypothesis that radionuclide concentrations or activity levels associated with the M&E exceed the action level (i.e., Scenario A). MARSAME also incorporates additional technical information from NUREG-1505 (NRC 1998a) and MARLAP for designing surveys using Scenario B where the null hypothesis is that the radionuclide concentrations or activity levels are less than the action level. The assignment of values to the lower bound of the gray region (LBGR) and upper bound of the gray region (UBGR), specification of decision error rates, and classification are all similar to information provided in MARSSIM.

MARSAME provides information on three different types of survey designs (see Roadmap Figure 6):

- Scan-only survey designs (Section 4.4.1),
- In situ survey designs (Section 4.4.2), and
- MARSSIM-type survey designs (Section 4.4.3 and MARSSIM Section 5.5).

Scan-only survey designs use scanning techniques to measure the M&E. In general, scan-only survey designs may be applied to all types of M&E, from small individual items to large quantities of materials to large, complex machines. Scan-only surveys range from hand-held instruments moving over the M&E to conveyorized systems that move the M&E past the detectors. Scan-only survey designs often require the least amount of resources to design and implement, and are easy to incorporate into SOPs or project-specific survey designs. In many cases it is not necessary to document the results of individual scanning measurements since it is easy to identify results that exceed some threshold corresponding to the action level. With the real-time feedback available during Class 1 scan-only surveys, the user can implement a “clean as you go” practice by segregating M&E that exceed the threshold for additional investigation. Drawbacks to scan-only surveys include increased measurement uncertainty because of variations in scan speed and source to detector distance making it difficult to detect or quantify radionuclides with action levels close to zero or background.

In situ survey designs use static measurements to measure the M&E. In situ surveys are generally applicable to situations where scan-only surveys are determined to be unacceptable. There are a wide variety of in situ measurement techniques available including box counters, portal monitors, in situ gamma spectroscopy systems, and direct measurements with hand-held instruments. In situ surveys are characterized by limited numbers of measurements with long count times relative to scan-only surveys, and often require more resources for planning and implementation relative to scan-only surveys.

MARSSIM-type survey designs combine a statistically-based number of static measurements or samples to determine average radionuclide concentrations with scanning to identify localized areas of elevated activity. MARSSIM-type surveys are designed using the information in MARSSIM. The process of identifying survey unit sizes, laying out systematic or random measurement grids, and calculating project- and item-specific area factors requires significantly greater effort during planning and implementation than either scan-only or in situ survey designs. In general, MARSSIM-type surveys of M&E are only performed on large, complicated M&E with a high inherent value after scan-only and in situ survey designs have been considered and rejected as inappropriate or unacceptable.

Measurement Quality Objectives

Measurement Quality Objectives (MQOs) are characteristics of a measurement method required to meet the objectives of the survey. Additional information on MQOs can be found in MARSAME Section 3.8 and Section 5.5, as well as MARLAP Chapter 3. MQOs are an important concept that was not presented in MARSSIM, and should be an important factor when evaluating existing survey designs and SOPs for applicability to surveying M&E.

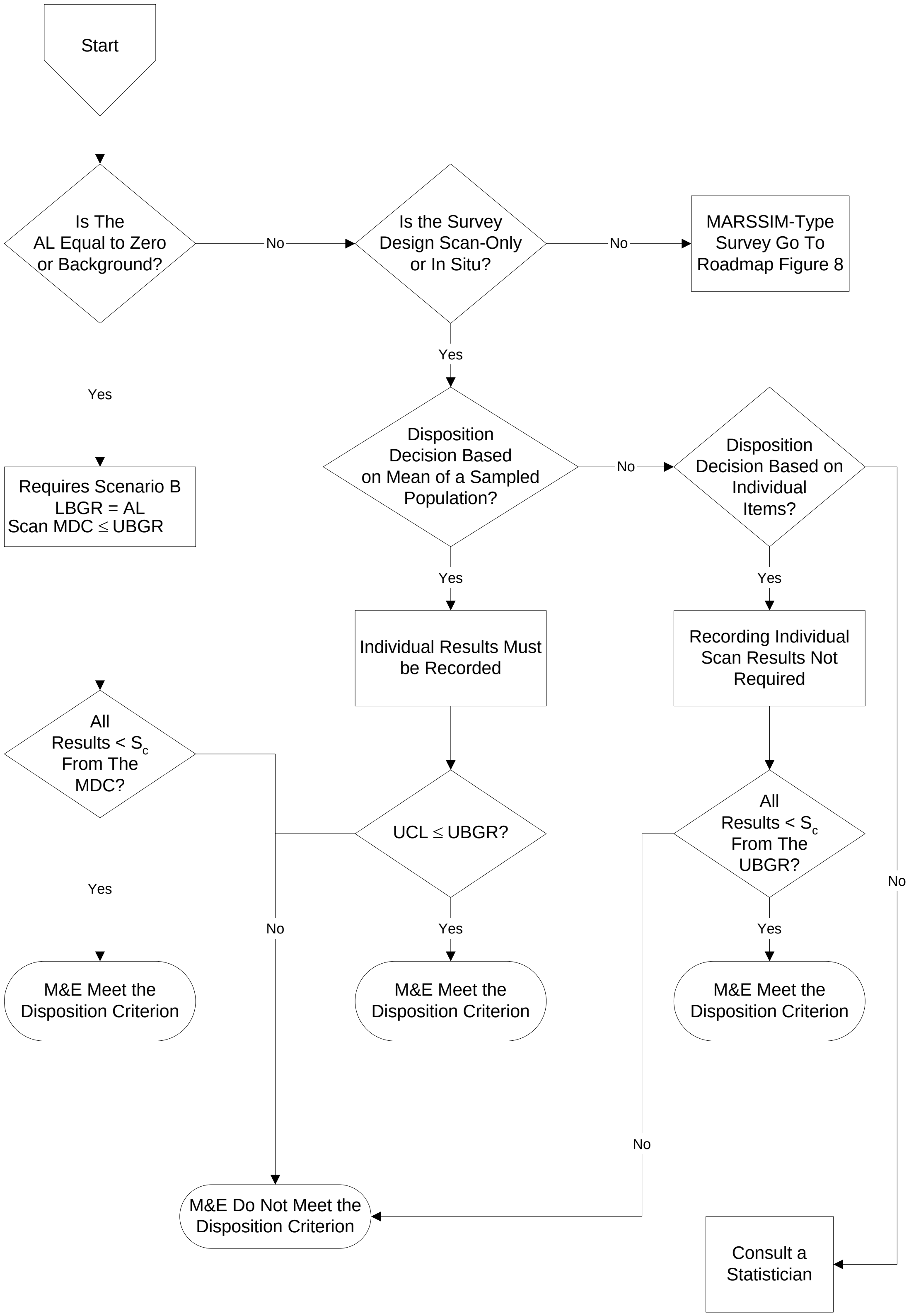
MQOs for a project include, but are not limited to:

- The measurement method uncertainty at a specified concentration expressed as a standard deviation (see Section 3.8.1 and Section 5.5),

- The measurement method's detection capability expressed as the minimum detectable concentration (MDC, see Section 3.8.2 and Section 5.7),
- The measurement method's quantification capability expressed as the minimum quantifiable concentration (MQC, see Section 3.8.3 and Section 5.8),
- The measurement method's range, which defines the measurement method's ability to measure the radionuclide or radiation of concern over some specified range of concentration or activity (see Section 3.8.4 and Appendix D),
- The measurement method's specificity, which refers to the ability of the measurement method to measure the radionuclide or radiation of concern in the presence of interferences (see Section 3.8.5), and
- The measurement method's ruggedness, which refers to the relative stability of measurement method performance for small variations in measurement method parameter values (see Section 3.8.6 and Appendix D).

Evaluate the Results

The assessment phase of the Data Life Cycle involves evaluating the results of the survey. DQA is used to evaluate the survey results. DQA is a scientific and statistical evaluation that determines whether data are the type, quality, and quantity to support their intended use. When individual measurement results are not recorded, as allowed in some scan-only survey designs, the preliminary data review will be brief and based primarily on the results of quality control (QC) measurements. To increase the flexibility and general applicability of MARSAME, several evaluation methods have been incorporated in addition to the Sign test and Wilcoxon Rank Sum (WRS) test used in MARSSIM. Roadmap Figure 7 presents information on interpreting survey results for scan-only and in situ surveys. Roadmap Figure 8 presents information on interpreting survey results for MARSSIM-type surveys.



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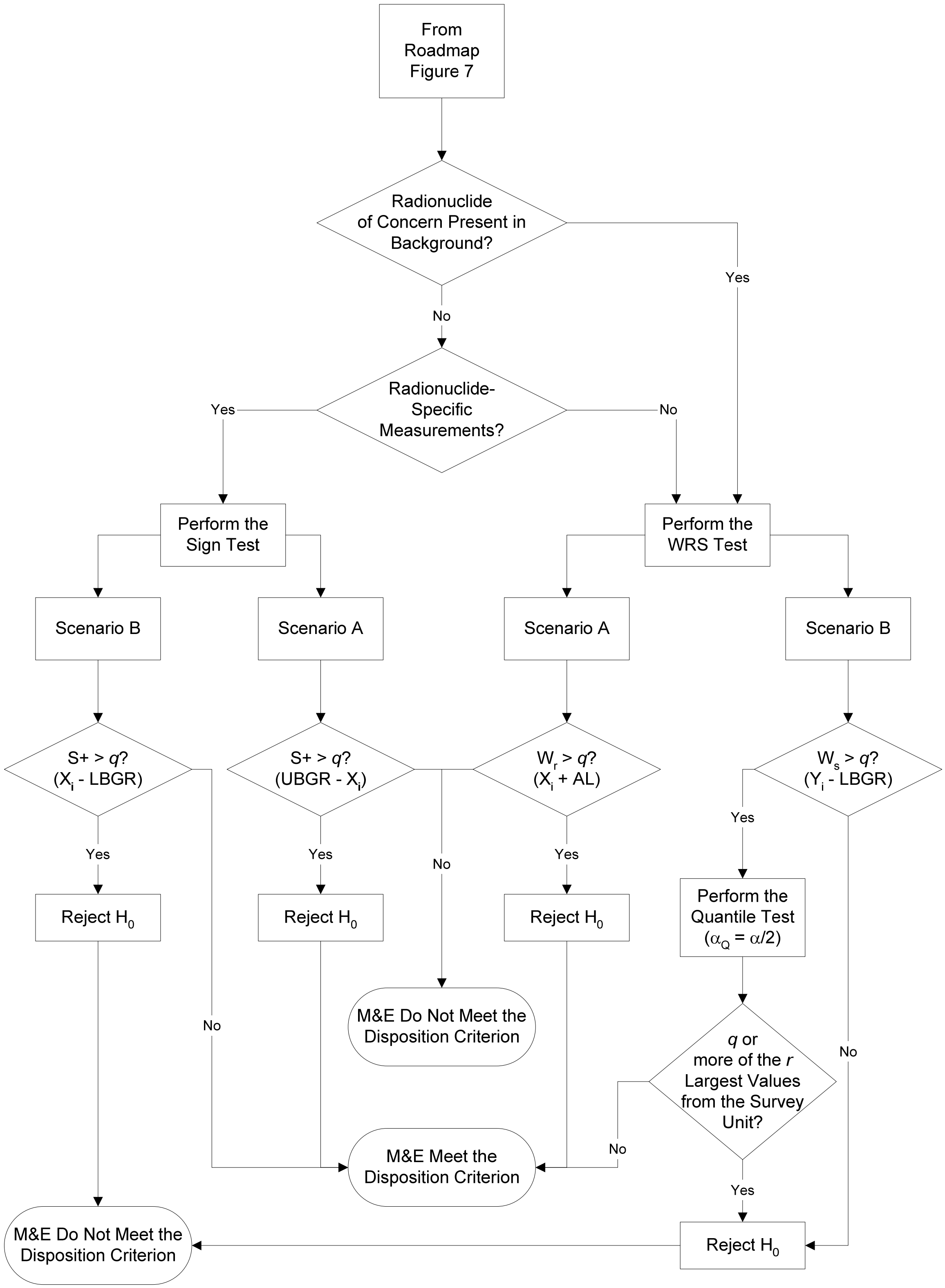
191 **Roadmap Figure 7. Interpretation of Survey Results for Scan-Only and**
192 **In Situ Surveys**



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194 **Roadmap Figure 8. Interpretation of Survey results for MARSSIM-Type Surveys**

Summary

The roadmap presents a summary of the Data Life Cycle as it applies to disposition surveys in MARSAME and identifies where information on important topics are located in MARSAME. Flow charts are provided to summarize major steps in the survey design process, again citing appropriate references in MARSAME.